DEVELOPMENT OF SMART PV TRAVEL PHONE CHARGER

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ABSTRACT

Solar energy is a one of the alternative renewable energy resource. The energy resource which directly produced by the sun can be converted to electricity by using solar cell. The applications that using photovoltaic technology is a solar cell phone travel phone charger. Solar cell phone charger can save energy compared to electric socket cell phone charger besides not contributing to environmental pollution. The weakness of this type of energy is it's depending on the existence or the brightness of sunlight. The project aims to develop charging cell phone using Photovoltaic (PV) otherwise to minimize electricity energy usage. The project also includes different from conversional phone charger due to this travel phone charger have storage battery to always be used when needed at certain times. In addition, this project using the buck converter circuit to monitor the voltage level of the continuous at rated 5 Volt even of the input voltage from solar cell is constantly changing. If the voltage from solar cell exceeds the permissible limits, its will be stabilized by using solar charge controller (SCC) to maintain and the voltage can be set to normal state using LM 2574 as step-down converter function. Thus the device will obtain a continuous power and protected from the effects of under voltage and overvoltage. Furthermore, this travel phone charger is also equipped PIC16F688 for the display using LCD in order to reading of the storage battery can always be observed during the running.

ABSTRAK

Tenaga solar merupakan salah satu sumber tenaga alternatif yang boleh diperbaharui. Sumber tenaga yang dihasilkan secara terus oleh sinaran cahaya matahari ini boleh ditukar menjadi tenaga elektrik dengan menggunakan Photovoltaic (PV) yang juga di kenali sebagai sel solar. Antaranya salah satu aplikasi yang meggunakan sistem ini ialah pengecas bateri telefon mudah alih. Pengecas bateri solar ini boleh menjimatkan tenaga berbanding pengecas soket elektrik yang sedia ada disamping tidak menyumbang kepada pencemaran alam sekitar. Kelemahan sumber tenaga ini adalah disebabkan kebergantungan kepada kehadiran atau kecerahan pada cahaya matahari. Tujuan projek ini adalah untuk membangunkan pengecas bateri telefon mudah alih dengan menggunakan Photovoltaic (PV) dalam hal lain untuk mengurangkan kebergantungan kepada penggunaan tenaga elektrik. Projek ini juga mempunyai kelainan daripada pengecas konvensional kerana pengecas telefon mudah alih ini mempunyai bateri simpanan agar sentiasa dapat digunakan apabila diperlukan pada waktu-waktu tertentu. Selain itu, projek ini menggunakan kaedah iaitu litar penukar perendah untuk memerhati tahap voltan dari sel solar secara berterusan pada kadar 5 Volt walaupun voltan masukan dari sel solar sentiasa berubah. Jika voltan dari sel solar melebihi tahap yang dibenarkan, voltan tersebut akan ditetapkan kepada keadaan normal menggunakan kawalan pengecas solar (SCC) untuk kekalkan dan voltan akan di tetapkan kepada keadaan normal dengan menggunakan LM2574 iaitu bertindak sebagai fungsi penukar perendah. Disebabkan itu, alatan akan mendapat tenaga yang berterusan dan dilindungi dari kesan akibat kekurangan voltan dan lebihan voltan. Disamping itu, pengecas mudah alih ini juga dilengkapi PIC16F688 untuk paparan LCD supaya bacaan pada bateri simpanan sentiasa dapat diperhatikan sepanjang proses berjalan.

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LIST OF SYMBOLS

I	Ampere
V	Voltage
PV	Photovoltaic
LED	Light Emitting Diode
LM2574	Step-down converter
LM7805	Voltage regulator
DC	Direct Current
AC	Alternating Current
LIB	Lithium-ion Battery
PIC	Peripheral Interface Controller
IC	Integrated Circuit
f	Frequency
I/O	Input/output
VDD	Supply Voltage
DVM	Digital Volt Meter
SCC	Solar charge controller
NPH	Normal Pressure Hydrocephalus

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CHAPTER 1

INTRODUCTION

1.1 Background

Due to the energy crisis, renewable energy sources have been deeply concerned as possible solutions to remain resources on the earth. Among these energy sources, solar energy, a free conversion, non-polluted and inexhaustible energy source, has been use to generate electricity for decades.

The solar energy which directly produced by the sun and it can be converted to electricity energy by using solar cell. For example, one of the applications that using Photovoltaic (PV) technology is battery charger cell phone. Solar cell is a device that converts the energy of sunlight directly into electricity by the photovoltaic effect. The main focus of this project is to design the charger with environmentally friendly materials and powered by alternative energy sources. The energy savings for battery charger cell phone is important in order to make sure that energy resource can be used for a long term.

This project consists of five elements which are Photovoltaic (PV) panel, solar charge controller, buck converter circuit (DC-DC Converter) with rechargeable battery (lead-acid type), PIC microcontroller and DC loads (lithium-ion battery). The buck converter circuit is used to set the normal charging voltage level at 5 Volt. The charge controller are used to stabilized the current and monitor the voltage or current level at solar cell. The PIC microcontroller aims to measure the battery storage from buck converter circuit.

1.1.1 **Advantages of alternative cell phone charger using Photovoltaic (PV)**

When using a solar cell phone charger it able to store electricity for a few days. There are several advantages when using the cell phone charger solar such as:

i. Plugging a charger to an electric socket can cause a shock to the wallet so using photovoltaic to charge batteries can save money.
ii. Invest in a solar battery charger not have to pay any bills and neither to pay maintenance costs.
iii. For the green consumer, rechargeable batteries are a great way to prevent toxic chemicals like alkaline from finding their way into landfills, or just reducing the cost of buying fresh, disposable batteries.

1.2 Objective

The objectives of this project are as follows:

i. To design a smart photovoltaic (PV) travel phone charger by using PIC16F688.
ii. To develop a DC-DC converter with stabilized output 5 Volts.
iii. To simulate the circuit by using Target 3001 and Proteus simulation software.

1.3 Scope

There are two main elements considered in this project which are:

i. To understand theoretical aspect of photovoltaic panel, PIC and including working principles, characteristics and specifications.
ii. To develop the travel phone charger using Photovoltaic (PV) systems.

1.4 System Description

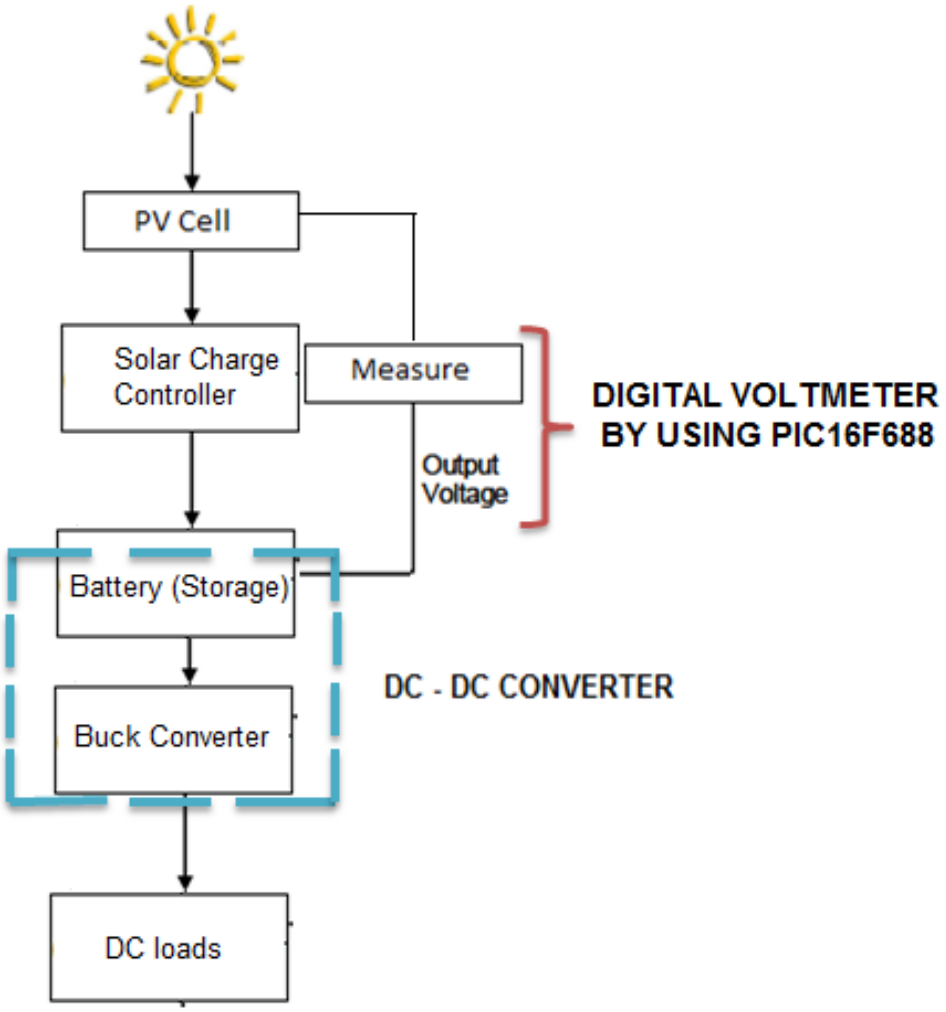

Figure 1.1: Global Block Diagram – Development of Smart PV Travel Phone Charger

The photovoltaic charger system consists of five subsystems, each with its own function. These five subsystems are connected in accordance with the block diagram presented in Figure 1.1.

The first subsystem (Solar Panel) consists of PV module as main element input source in this project. This PV module has a rated power in 9.4 V and is formed by 3 photovoltaic cells connected in parallel (more technical specifications may be consulted in detail). Due to not have suitable rated, these solar panel cells are used in project.

The Solar Charge Controller (second subsystem) is used to increase the current in 1 Ampere due to the solar panel cannot support current for charging process. If current not enough, the charging process cannot charging with successfully. Furthermore, it can be apply to backup support from overcharging for storage battery in charging process occurs after diode zener at buck converter circuit.

The DC-DC Converter element (third subsystem) consists of one rechargeable battery from lead-acid types and buck converter charging unit. It due to lead-acid battery has high capacity storage from other battery in Photovoltaic systems [11]. The buck converters are used for step-down or stabilized voltage at 5 Volt (suitable for phone charger charging).

The DC loads (fourth subsystem) consists of a rechargeable Lithium-ion (Li-ion) battery from mobile phone. This battery has an output voltage of 3.7V and an energy storage capacity of 550mAh/1000mAH (depends the type of capacity battery are used for mobile phone from supplier)

The measurements (fifth subsystem) are used to measure capacity of the storage battery at the buck converter and solar panel by using PIC16F688. If the full charge battery capacity, the LCD act as display with 6V depends the type battery are used in the project.

1.5 Problem Statement

Nowadays, the portable equipments relying on the solar energy as a power supply are widely used in the daily life [1]. With the increase of the energy demand and the concern of environmental pollution around the world, photovoltaic (PV) system is becoming more and more popular [1]

Due to the energy crisis, alternative energy sources have been deeply concerned as possible solutions to remain resources on the earth [2]. Among these energy sources, solar energy, a free conversion, non-polluted and exhaustible energy source, has been used to generate electricity for decades [2].

The main purpose of establishing the working of mobile phones using solar energy is to overcome the constraint of enormous emission of Carbon-di-Oxide in to the atmosphere, hugely contributing to the depletion of ozone layer [3]. By using the photovoltaic (PV) system, the system depends on sun energy as power supply which is only available in limited period. It causes the limited energy supply. So, the system must use the energy as minimum as possible but still can operate efficiently

A solar cell phone charger uses the energy of the sun to charge up mobile phone. If someone are outdoors a lot, or do not have ready access to an electrical outlet, getting a telephone charged can be principal hassle. With a solar cell phone charger, we can easily use the energy of the sun to charge cell phone anytime and anywhere. Using photovoltaic cells, a solar cell phone charger can rapidly turn the power of the sun into electricity. This electricity can be used to recharge telephone anywhere. A solar panel phone charger can be vital on a camping trip or an outdoor adventure travel.

1.6 Outline of Thesis

This Development of Smart PV Travel Phone Charger final thesis is consists of five chapters including this chapter. The content of each chapter are outlined as follows.

For Chapter 1(Introduction) it will be described about the introducing the overview of the project including the background, objectives, problem statement and scope of the project.

For Chapter 2 explained about the reviews on previous researches conducted that is related to this project. Before starting the project, the background and literature review about development of smart PV travel phone charger has been studied in order to understand more about the operation and principle of charger solar.

For Chapter 3 it includes the project methodology. This will explain how the project was organized and the flow of the system designed. Before developing the prototype, the simulation has been done to make sure that the circuit would be working properly.

For Chapter 4 explained the result and discussion. The result will be analyzed and discussed. This chapter shows the result achieved by doing this project. The result are categorized into three parts includes the hardware, software and analysis of the system.

For Chapter 5 will be explained about the conclusion from this project. The overall conclusions of this project that have been completed. The final chapter which is chapter five elaborates the conclusion and recommendation of the project. The

future works are recommendation and suggestions made for the project to improve in near future

CHAPTER 2

LITERATURE REVIEW

2.1 Solar Energy

Solar energy is the light and radiant heat from the sun that influences Earth's climate, weather and sustains life. Solar power is sometimes used as a synonym for solar energy or more specifically refer to electricity generated from solar radiation.

Solar energy technologies can provide electrical generation by heat engine or photovoltaic means, space heating and cooling in active and passive solar buildings, portable water via distillation and disinfection, day lighting, hot water, thermal energy for cooking, and high temperature process heat for industrial purposes. Solar energy refers primarily to the use of solar radiation for practical ends. All other renewable energies other than geothermal derive their energy from energy received from the sun.

Currently, our society's energy demands are fulfilled using conventional energy sources such as water, coal, oil, natural gases or uranium [4]. The production of energy using these conventional sources is a cause of concern of many environmentalists [4]. The major problems can be quoted as follows:

i. It causes atmospheric pollution, climate changes or nuclear waste and thus can endanger our living condition on the earth.

ii. The extensive use of these limited conventional energy sources may result in complete depletion of energy sources and hence, there is no guarantee of energy supply for future.

The above mentioned problems can be solved by using renewable energy sources such as sun and wind. The renewable energy sources use natural resources and do not cause any pollution. Hence they are termed as green energy sources [5]. Moreover, these renewable energy sources only use a small part of the flow that is why they cannot damage natural surrounding and also do have the risk of being depleted. Sun is considered as a potential source of renewable energy. Hence, the use of solar energy for applications such as generation of electricity, running of automobiles, etc is becoming popular. The generation of electricity using solar energy is done using photovoltaic technology [6].

2.1.1 Advantages of Solar Energy

Solar technologies are broadly characterized as either passive or active depending on the way they capture, convert and distribute sunlight. Active solar techniques use photovoltaic panels, pumps, and fans to convert sunlight into useful outputs. The advantages of solar energy are as following:

i. Solar energy is a renewable resource. Although it cannot be utilized at night or on cloudy days, its availability may be generally relied upon day after day.
ii. Solar cells are long-lasting and require very little maintenance.
iii. Solar energy is non-polluting. Of all the advantages of solar energy over oil, this is perhaps the most important. The burning of oil releases carbon dioxide and other green house gases into the air. In addition to this, the process of obtaining it may result in damaged ecosystems through dredging or spills.

iv. Although solar panels and their accessories (solar lights, etc.) may be expensive to buy at the onset, money is saved in the long run. This is because energy from the sun is widely available and free.

v. Solar powered lights and other solar powered products are very easy to install. This is because there are few wiring issues and little need to ever dig supporting trenches.

2.2 Photovoltaic (PV) Cell

On the thesis the solar panel serves as power supply to the circuit. It receives light from the sun and converts this to energy. The photovoltaic cell is a usual power source where as most sources of electrical power are constant voltage sources, such as a battery, a PV cell is a constant current source. The PV cell only displays this constant current characteristic up to a limiting where the current collapses. For an ideal PV module the voltage where the current collapses would be at the open circuit voltage, Voc

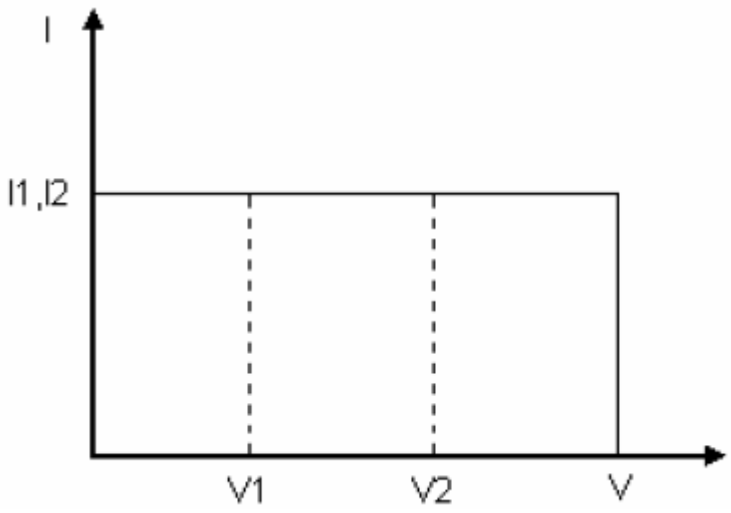

Figure 2.1: Ideal I-V Curve for a PV cell

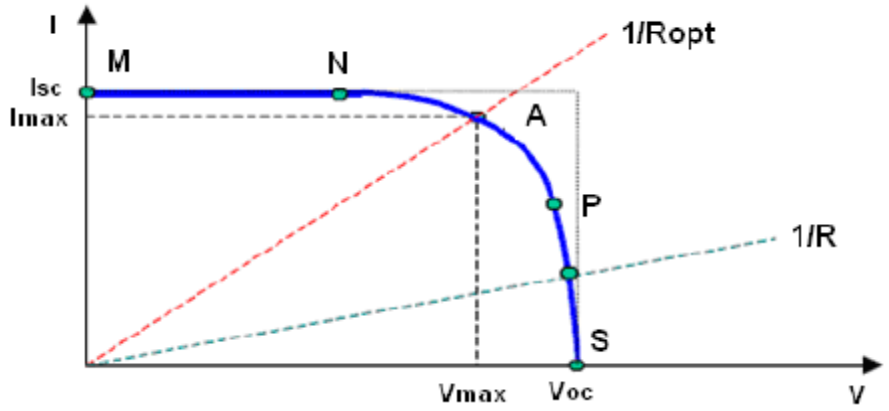

Figure 2.2: Typical current-voltage I-V curve

The slight current drop between points M and A is a result of some of the current passing through the internal resistance of the PV cell. Between points A and S the load resistance increases forcing some of the current to flow through the diode resulting in the fast drop in current to the load. This continues until point S where all the current flows through the diode and the internal resistance.

Where the PV operates on this I-V curve is greatly determined by the insulations, array voltage, cell temperature and the load connected to the array. According to [14] by altering the amount of sun light that is available to the PV module the current that the module can produce is also altered. The current and power output of the used solar panel is approximately proportional to illumination intensity (irradiance). At a given intensity, the module voltage is determined by the characteristics of the load.

According to the conclusions achieved in [15] the effect of temperature on the current of a PV cell is only small. By increasing the temperature a slightly higher current is produced, however this increase in temperature has a negative effect on the cell voltage. Increasing the temperature forces the diode in Figure 4 to conduct at a lower voltage therefore reducing the PV voltage where the curve collapses and greatly reducing the output power

Figure 2.2 shows the load lines for different load resistances. The slopes of these load lines are given by 1/*R*. So, lower resistances result in steeper load lines